



Summary of Light Output Studies

Dan Cronin-Hennessy

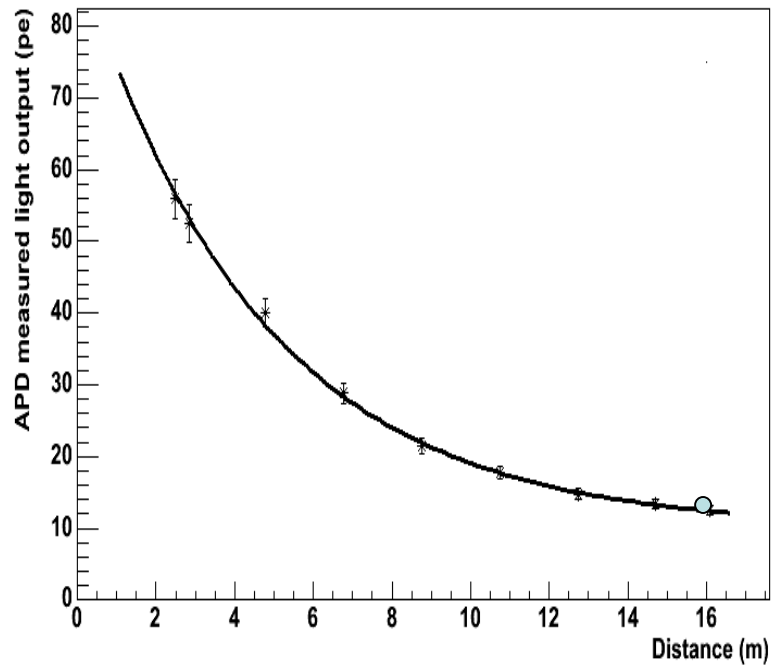
NOvA Meeting

Aug 27, 2005

Fermilab

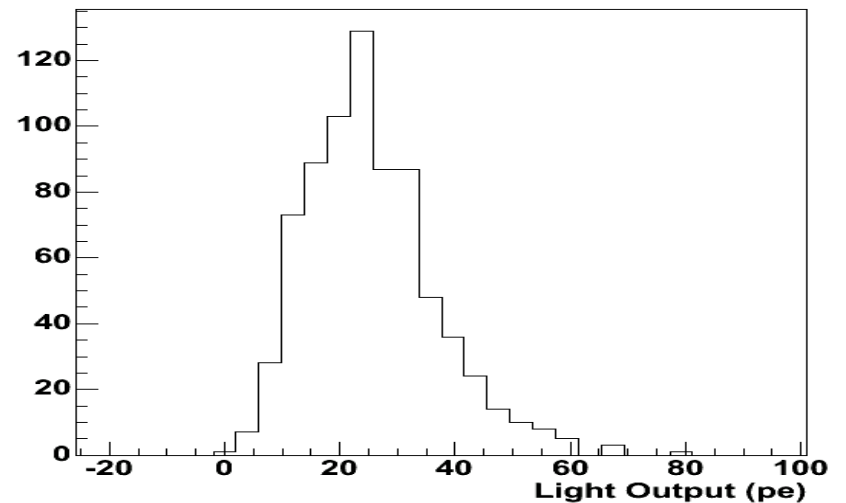
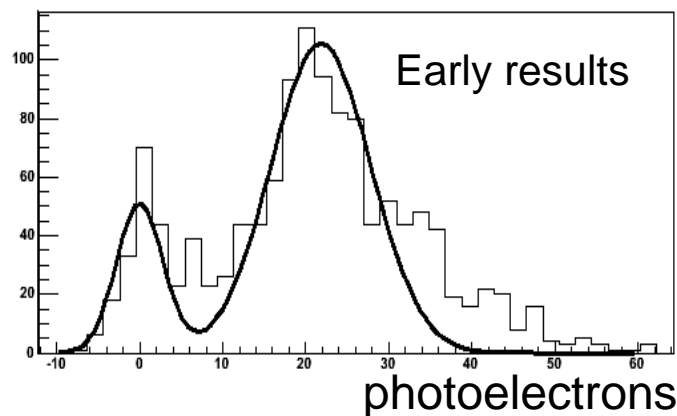
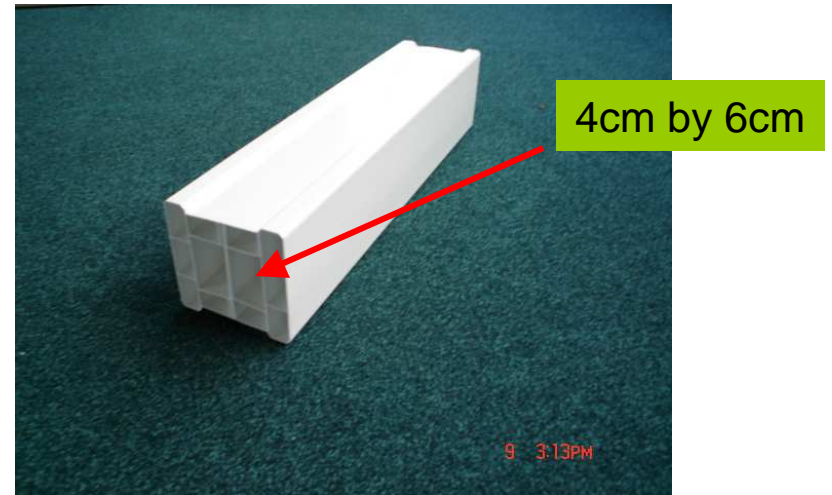


Vertical Slice Test



Cell Size

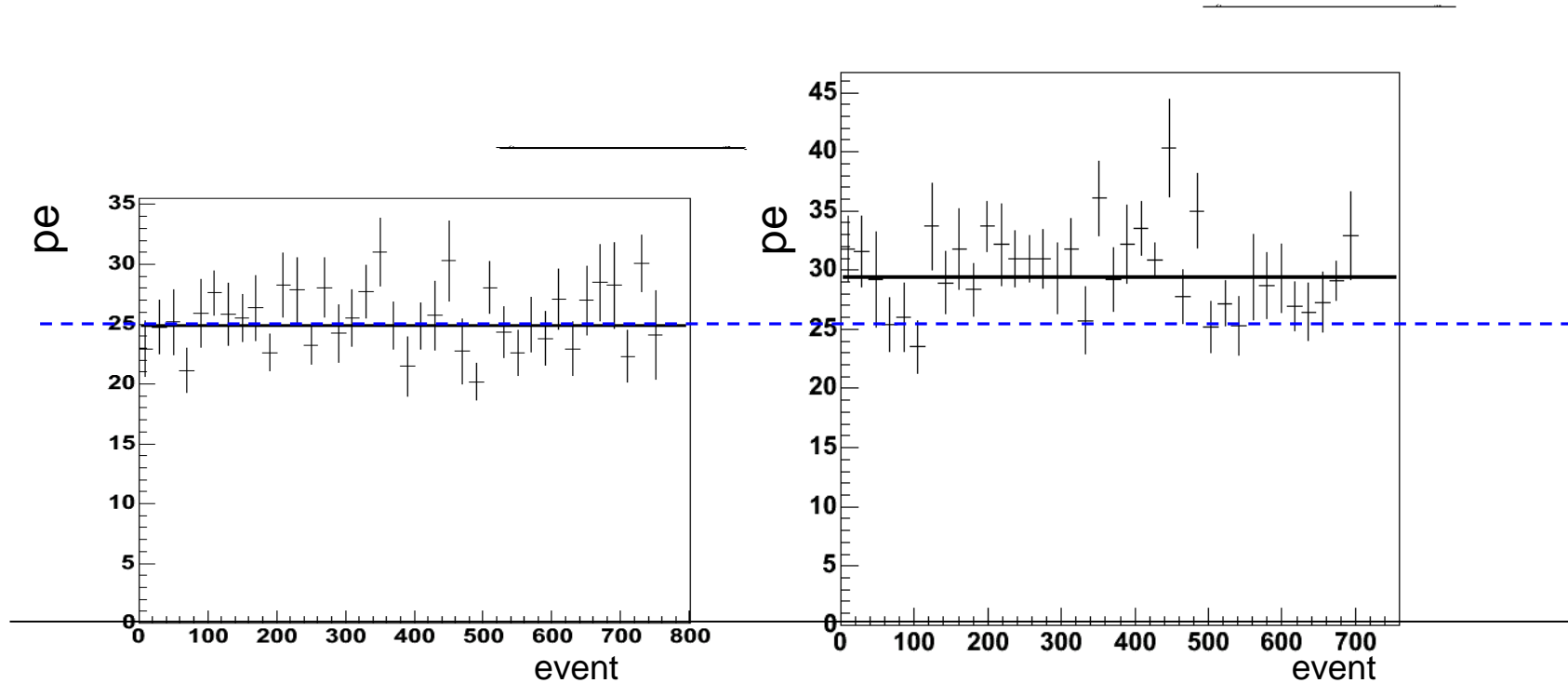
- Realistic cell size manufactured from existing extrusions.
- Cosmic data shows EM contamination.
- Outer cells used for tracking/veto.



Reflectivity

PET-PRIME

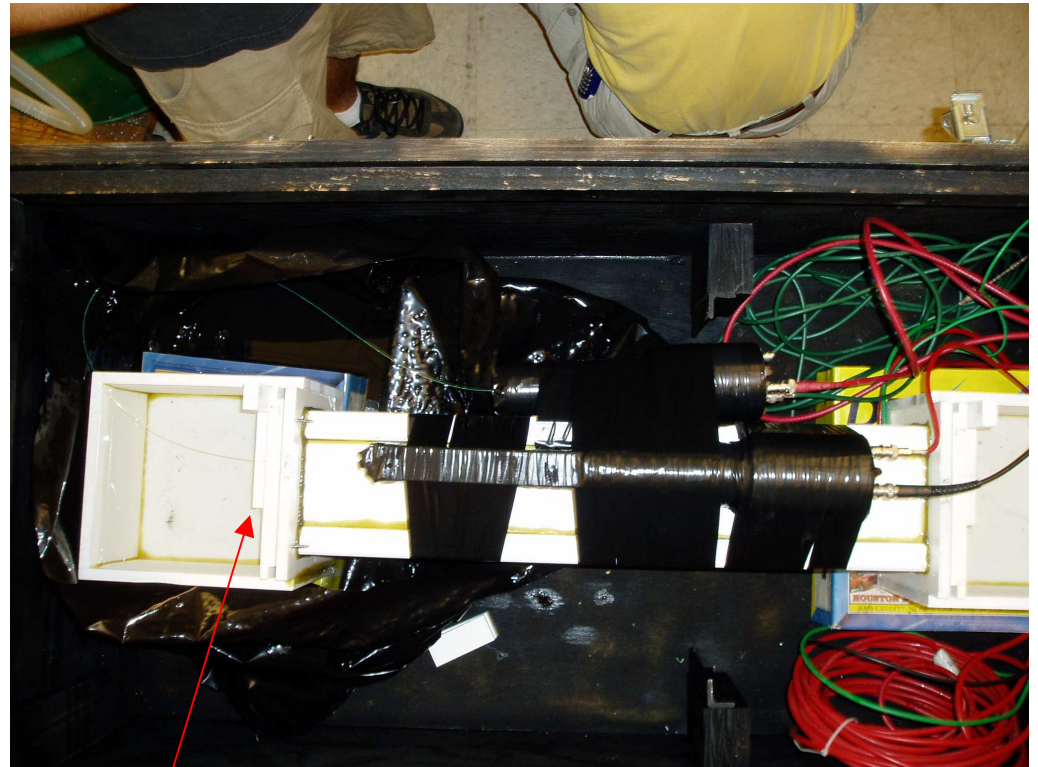
Type B



~13% increase in pe

Fiber Location

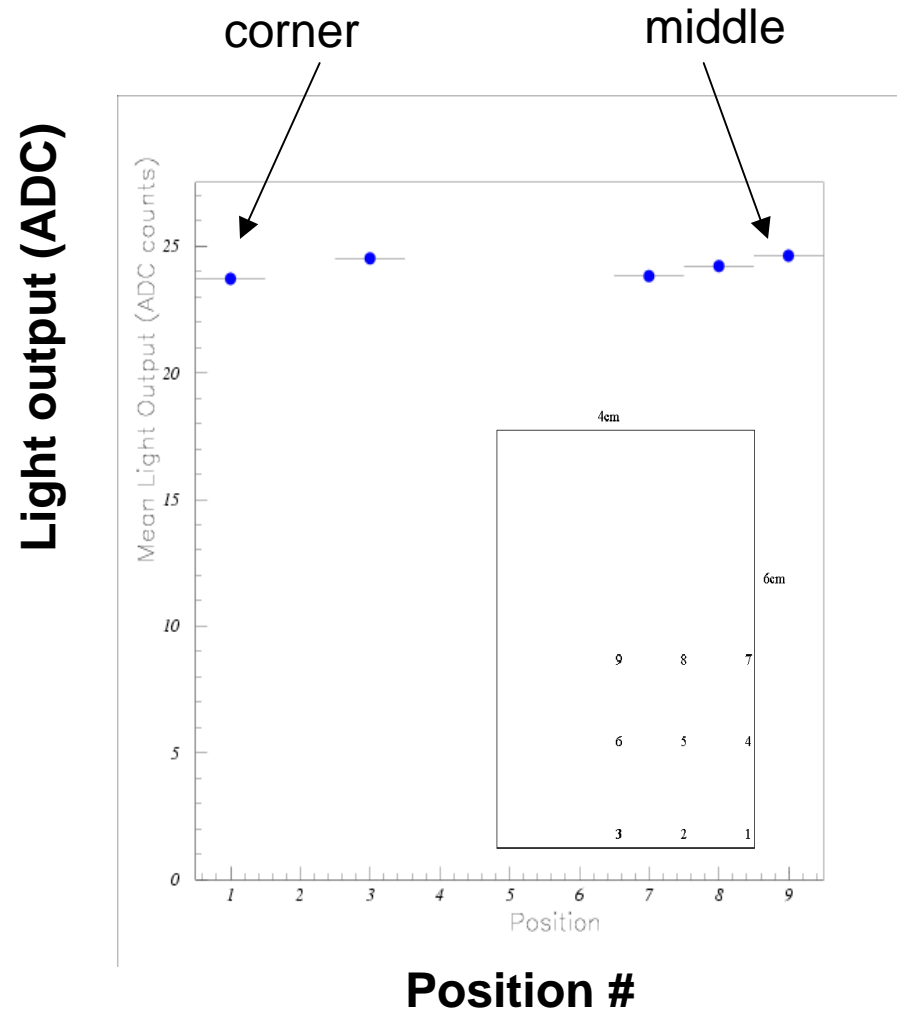
- Simulations from Ruddick predict light output as a function of fiber position within a cell.
- Significant Light losses occur at edges corners
- Fiber chooses its own position
- Light output gains may be achieved with fiber position control system



Sliding plate with fiber slots

Fiber Location

- Preliminary data acquired
- Measured at 9 positions
- Mild losses at critical regions observed.
- Significant losses expected only when fiber is very close to edge.
- Modifications needed for accurate placement.



Summary

- Recent work:
 - Full length extrusion test, cell size test, fiber location, and PVC color dependence (reflective paint), shadowing, PVC transparency.
 - Non-accelerated aging, fatigue from bending.
- Photon backgrounds.

NOvA Summer Students

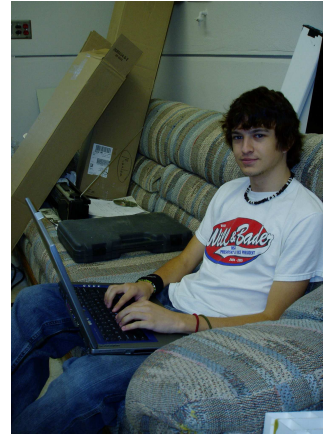
UROP -Undergraduate Research Opportunities
REU -Research Experience for Undergraduates
Start-Up and University



Tom Kelley
Matt Strait



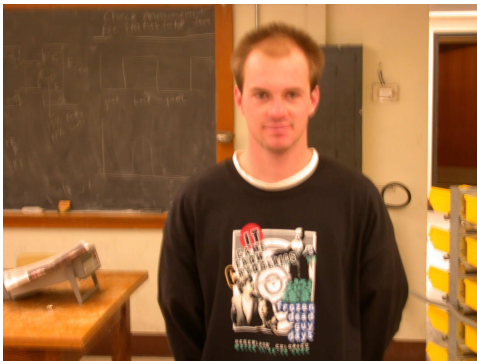
Eric Hazlett



Matt Powers



Mohamed Abdullah



Alex Childs



Nicholas Becker

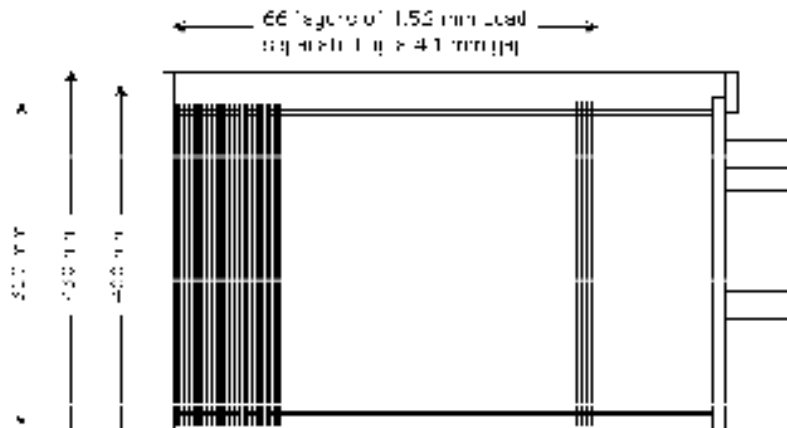
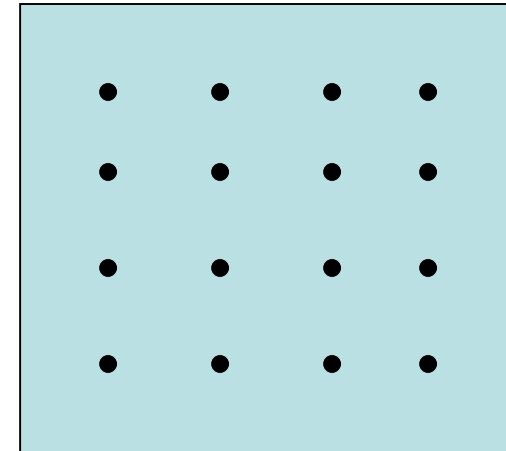


Ben Juwono

Calorimeter

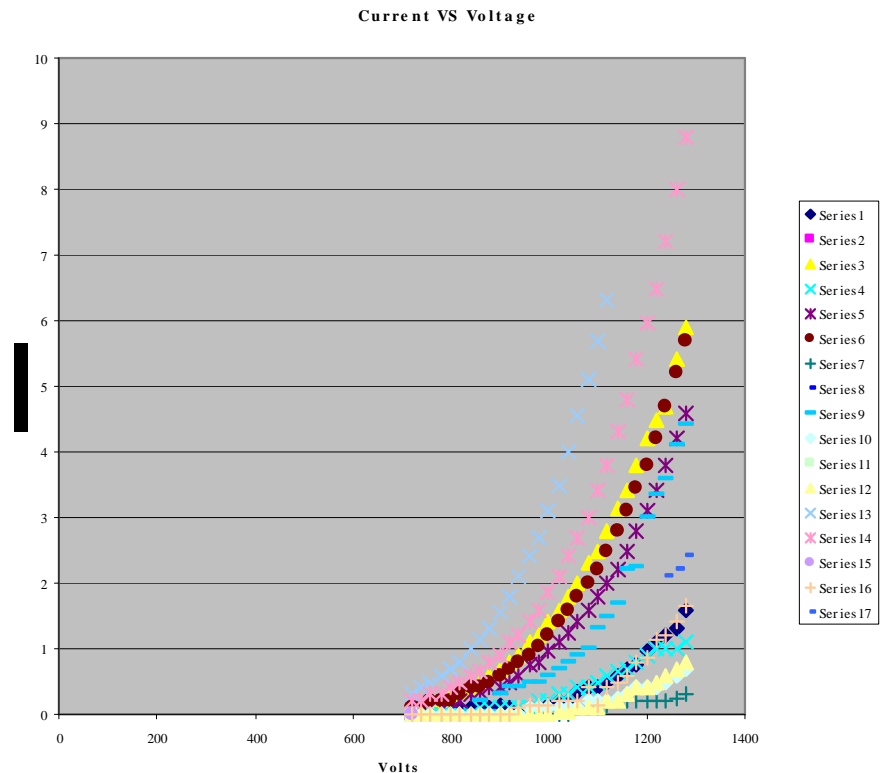
- Prototype for EM Cal for COSMOS (E803)
- Shashlik design lead-liquid-scintillator calorimeter.
- Scintillator BC517-L
- Fiber BC91-A
- 25 5cmx5cm
- 16 fibers per tower
- Mirrored ends (800 nm aluminum deposition)
- 66 1.52 mm lead plates (4.1 mm gap)

Tower



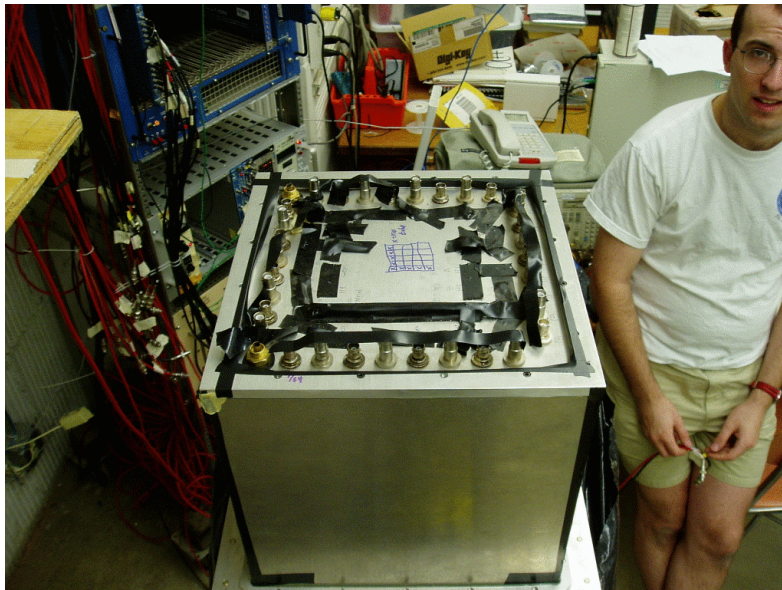
Phototubes

- Tubes: EMI 9133
- Relative gain measurements performed by current measurements with standard light source.
- Absolute Gain measurements with pulsed and DC LED source.
- Repeat of manufacturer's
- Of 17 tubes 9 appear to be consistent with those a decade ago.



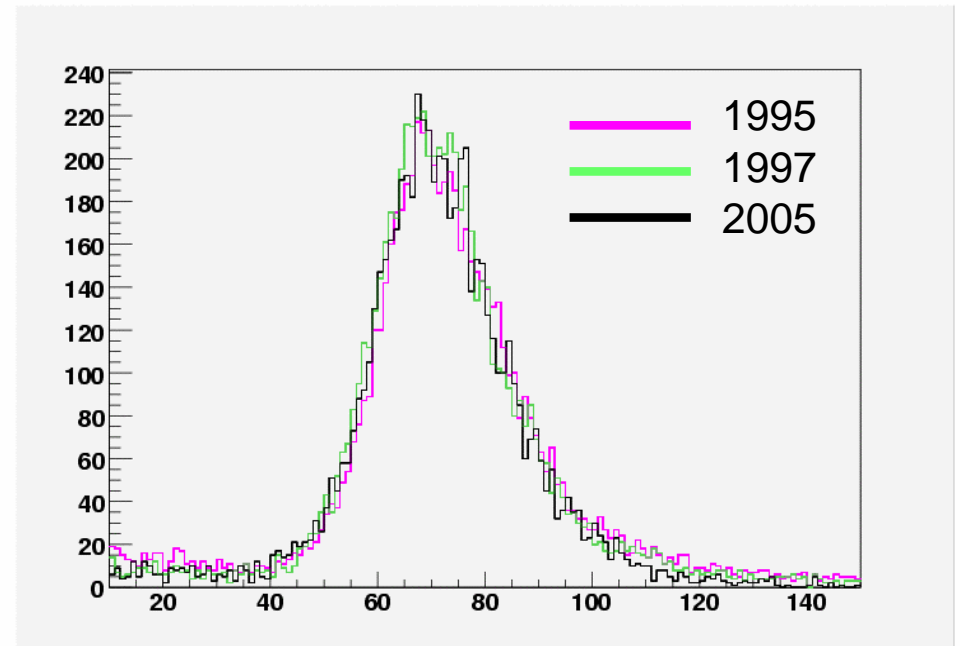
Calorimeter Revival

- Summer project for new grad (Matt Strait)
- Revive calorimeter.
- Scintillator BC517-L (same as NOvA)
- Vertical cosmic ray runs. Various voltages.
- 5 cm lead shielding.
- 4x4 array of towers (4 inner towers used for measurement) .
- Compare ADC dist. Look for tower to tower variations.
- Turn calorimeter on side and scan horizontal.



Results

- Impressive agreement with last decades data.
- Caveats:
 - DAQ, Readout, Trigger and shielding
 - Phototubes
 - Analysis of data
- At this time statement on performance relative to old data of order 15-20%.

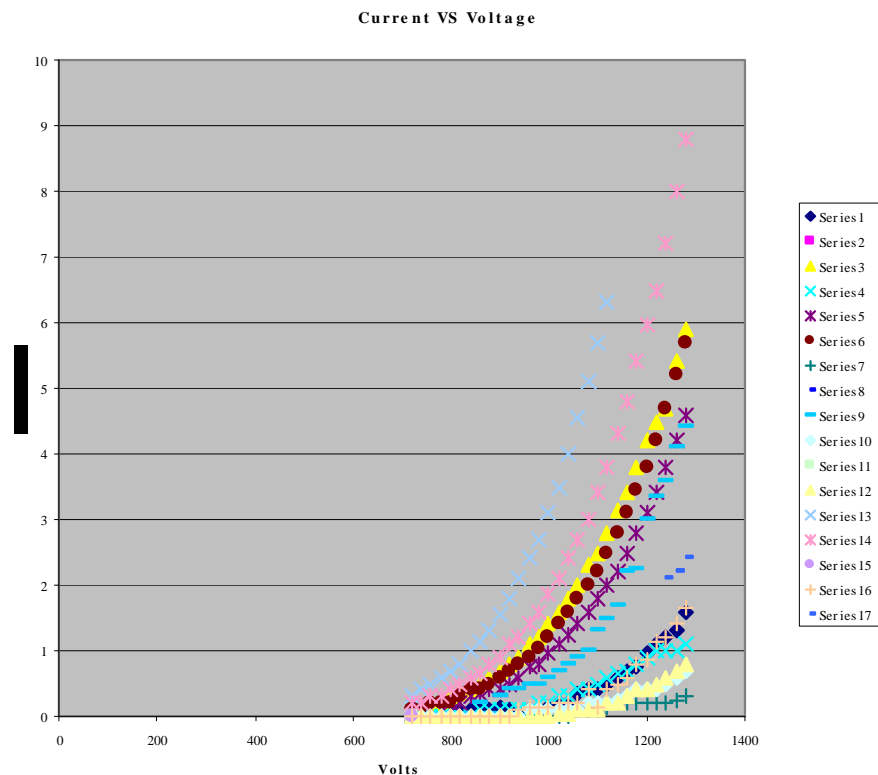


Normalization uncertainty on mean of 16%.

More robust width to mean ratio shows 3% difference (statistically insignificant).

Summary

- No detectable degradation of light output. Hope to improve sensitivity with better understanding of systematics. Recalibration of tubes planned.
- No tower to tower variation observed. Data accumulating.
- Horizontal scanned showed increased light output at far end.
- When runs are complete we may open and examine fibers.



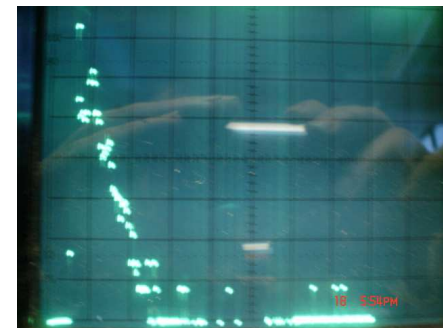
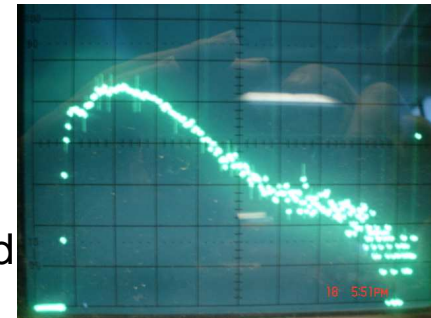
Aging Studies

- Issue
 - Loop design introduces high curvature fiber at end of extrusion.
 - Possible fatigue of fiber that could compromise light output.
- Long term monitoring of fiber performance in setup that allows various size loops.
- One box completed more planned.
- A couple may be subjected to accelerated aging.



Additional Learning

- Data from day one.
 - DAQ = Sony 3M Digital Camera + ruler.
 - PVC transparent
 - Stock tip: GLAD
 - Trapped air during filling.
 - Seal designs
 - Fiber shadowing and light output budget adjustments. (~30% effect)
- ~10 cm exposed



NOvA note det-78: Mualem
Quantified transmission
Proposed light tight scheme

Time and Motion

- Prototype for Fiber Manifold – Tom Chase
- Used for timing studies which forms basis of current fabrication time.



Threading looped fiber within a 15.7 meter extrusion (shop vac → 3 seconds).
Students explored speed control and multiple cell threading.

Time and motion studies in infancy.